TP 91
REFERENCE
MANUAL

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REV 1.2 : 15/11/91

Contents

INTRODUCTION

The TP91 has been specifically designed for precise temperature control of the Linkam heating/freezing stages. The stage sensor is digitally linearised to give an accurate temperature readout and the controls and their functions have been carefully chosen for simple and easy operation. Limit values are changed by simply turning a knob on the front panel until the new value is displayed. Heating or cooling rates can be changed almost instantly using the three rate keys.

An optional remote control gives single key control of three programmable heating/cooling rates and the HEAT, COOL and HOLD functions. The three programmable rates are held in memory when power is switched off. The temperature and limit values can also be stored and recalled using the remote control.

An analog temperature output is provided and is scaled at 1 mV/°C with an offset of 200 mV when used with the THM600/HFS 91 stages as these are capable of cooling to -200°C.

The contents of the front panel display can be superimposed onto a video camera signal using a Linkam VTO232 Video Interface from the output provided.

Finally a computer serial port is included which gives access to all the functions of the TP91. This could be used for data storage or for control of other equipment whose functions depend on values read from the TP91.

USING THE TP 91

Rate step key

If the rate is in the range 0.1 to 0.9 the rate step key will increment the value by 0.1. When 0.9 is reached and the key is pressed, the rate will change to 0.1. Similarly if the rate is in the range 1 to 9 then it will increase by 1 and if the range is 10 to 90 then it will increase by 10.

	0.9 25.1 26
RATE STEP	0.1 25.1 26

Rate /10 key

The RATE / 10 key will divide the current rate displayed by 10. Once the rate is in the range 0.1 to 0.9 then it will no longer function as this is the minimum rate range available.

	30 25.1 26
RATE / 10	3 25.1 26

Rate X10 key

The RATE X10 key will multiply the current rate displayed by 10. Once the rate is in the range 10 to 90 then it will no longer function as this is the maximum rate range available.

	4 25.1 26
RATE X 10	40 25.1 26

Hold key

Pressing the HOLD key keeps the temperature at the current value and only functions when the TP91 is heating or cooling. If selected the word HOLD and the rate value will alternately flash. Whilst in the hold mode the rate and the limit may be changed. Pressing the HEAT/COOL key will cancel the hold mode and set the TP91 to heat or cool in the direction set before the HOLD key was pressed. If a new limit value is set during hold and the HEAT/COOL key is pressed then the new limit value will determine the direction of heating or cooling.

HOLD	HOLD 25.1 26

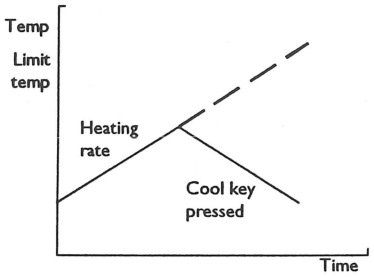
Heat/Cool key

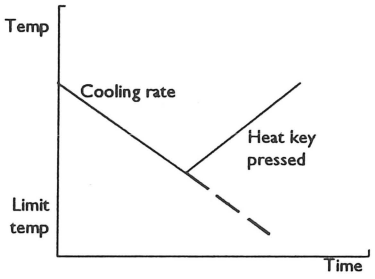
When the START key is pressed the TP91 will determine the direction of heating or cooling according to the limit value set. The internal ramp that the temperature is following will either heat or cool at the rate set until the limit is reached. Whenever the ramp is cooling the COOL led will be on.

Pressing the HEAT/COOL key sends the ramp in the opposite direction and cancels the hold mode. If the TP91 is cooling to a limit and the key is pressed, the word HEAT will appear where the limit value was and the TP91 will start to heat. If left for long enough the temperature will reach it's maximum value of 600°C and the TP91 will reset. If the TP91 is heating to a limit and the key is pressed, the word COOL will appear where the limit value was and the TP91 will start to cool. If left for long enough the temperature will reach it's minimum value of -200°C and the ramp will hold, waiting for either the limit to be changed or theHEAT/COOL key to be pressed again.

The ramp direction set by the HEAT/COOL key will be overridden if the limit is changed.

If the stage is unable to cool at the rate set then a flashing asterisk will appear in the display.This could occur if the rate set was greater than the natural cooling rate of the stage or if coolant was being used, that the flow rate was not enough.





STEP	PRESS KEYS	DISPLAY
Limit is lower than the temperature so the TP91 is cooling.		30 121.0 75
Press HEAT/COOL key to override the programmed cool.	HEAT COOL	30 118.5 HEAT
Press the HEAT/COOL key again to start cooling back to the set limit of 75°C.	HEAT COOL	30 135.1 75

Start / Finish key

When the START / FINISH key is pressed the TP91 will start heating to the limit value set.

THERE WILL BE A DELAY OF APPROXIMATELY 8 SECONDS BETWEEN PRESSING THE KEY AND THE LOAD LIGHT FLASHING WHICH INDICATES THAT THE STAGE IS HEATING.DURING THIS TIME NO KEYS WILL FUNCTION.

As an indication that the TP91 has started to heat an asterisk (*) will appear in the display. This will disappear once the load light has flashed.

This key does not function when the computer serial link is in operation.See section 4.0.

The following example shows how to set a rate of 4 °/ min to a limit of 105°C.

STEP	PRESS KEYS	DISPLAY
Switch TP91 on.		30 25.1 26
Set the rate to 4°/min.	RATE / 10	3 25.1 26
	RATE STEP	4 25.1 26
Turn the LIMIT knob until the required limit is displayed. e.g. 105°C.	LIMIT	4 25.1 105
Press START to begin heating.	START	4 * 25.1 105

LIMIT CONTROL

Turning the limit control increases or decreases the displayed limit value and will also cancel the HEAT or COOL modes.
When cooling to a limit the COOL led will be on and if the programmed cooling rate is greater than the cooling rate of the stage by more than about 2 ° C a flashing asterisk (*) will appear inthe display. When a limit is reached, either through heating or cooling the COOL led will be switched off.

STAGE CONNECTOR

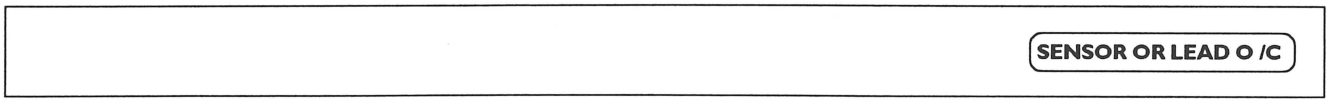
This 15 way 'D' type connector is used to connect the TP91 to either the HFS91 or the THM600 stage. The HFS91/THM600 stage use a platinum resistor to sense the temperature which is precisely measured using a 4 wire ohm method. This method of measurement helps to prevent the resistance of the cable adding to the sensor's resistance and therefore affecting the measured temperature .
An analog temperature signal of 1 mV / ° C is provided which has an offset of 200 mV when used with the HFS91/THM600 stages.This is to overcome the negative temperatures and therefore avoids having an offset on the chart recorder.

STAGE / PU1500 CONNECTIONS

PIN NUMBER	CONNECTION
9	current source output
2	current source output 0v
1	measurement input
10	measurement input 0v
8	HFS91/THM600 stage power
15	HFS91/THM600 stage power
5	Analog temperature output
12	Analog temperature output 0 volts

TP91 RESET

If the stage is disconnected or if a fault occurs the following message will be displayed.
Once the stage is re-connected or the fault is rectified the TP91 may be reset by pressing any of the front panel keys.



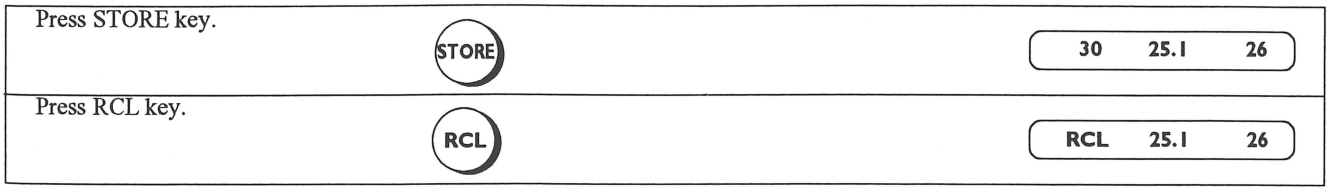
REMOTE CONTROL

Connecting the remote control

The remote control has a cable with two 'D' type plugs attached to it.One of these plugs has two cables coming out and it is this one which is plugged into the rear connector marked VIDEO/REMOTE of the TP91

Using the remote control

The remote control's HEAT, COOL and HOLD keys work in the same way as the HEAT / COOL and HOLD keys on the front panel of the TP91 The only difference being that the single switch function of HEAT / COOL is separated into two switches on the remote control. The three keys marked R1,R2 and R3 instantly change the pre-programmed heating /cooling rates and are set up as shown in section 3.3. It is also possible to store and recall a temperature and limit value using the STORE and RCL keys on the remote control.



When the stored value is recalled the word RCL will appear where the rate was displayed. While the recalled value is displayed the temperature of the stage will be held constant. i.e.hold. When the STORE key is pressed the old value will be lost.

Programming the remote control rates

The three keys marked R1, R2 and R3 can be programmed to represent any valid rate value. These rate values will remain in memory when power is removed and are set as follows:-

1) Switch off the TP91 and wait for 5 seconds.
2) Switch on and immediately press the RATE STEP key.
3) Proceeed as shown below.

STEP	PRESS KEYS	DISPLAY
Switch TP91 on. Press the RATE STEP key as soon as this message appears.	RATE STEP	LINKAM TP91
The rates already set are displayed and an asterisk appears for the rate value that is to be changed.		*=10 2=20 3=30
If the rate is to be changed use the appropriate keys as shown in sections 2.1 to 2.3.	RATE / 10	*= 1 2=20 3=30
When the rate has been set press HOLD. The asterisk will move to the next rate value to be changed.	HOLD	1= 1 *=20 3=30
When all the values have been set press the START key.	START	1= 1 2=20 3=30

COMPUTER SERIAL PORT

If the optional PT91 printer has been used on this port, the TP91 must be reset so that the printer is no longer used. See section **TP91 printer on/off control.**

Typical pin connections for Personal Computer

TP 91 to 9 way 'D' type

TP 91		PC	
TX	pin 2	RX	pin 2
RX	pin 3	TX	pin 3
RTS	pin 4	CTS	pin 8
CTS	pin 5	RTS	pin 7
GND	pin 7	GND	pin 5
		DSR	pin 6
		DTR	pin 4

TP 91 to 25 way 'D' type

TP 91		PC	
TX	pin 2	RX	pin 3
RX	pin 3	TX	pin 2
RTS	pin 4	CTS	pin 5
CTS	pin 5	RTS	pin 4
GND	pin 7	GND	pin 7
		DSR	pin 6
		DTR	pin 20

The TP 91's serial computer port follows a DTE pinout and uses a RTS/CTS handshake.The signal levels for TX and RTS are standard RS232,but for RX and CTS both RS232 levels or logic levels will be accepted.
If your computer does not drive CTS then connect pin 5 to the computers DTR line and DSR line.

RS232 commands

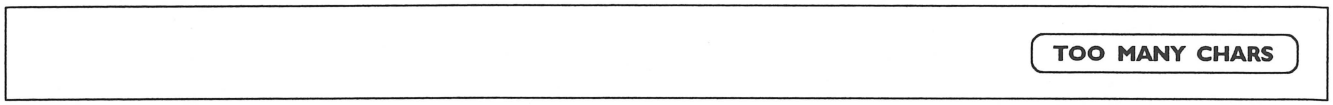
The baud rate used is 9600 with 8 data bits,1 stop bit and no parity.
All commands or data received must end with a carriage return.A carriage return is also included at the end of all transmissions from the TP91 to the computer. All commands use UPPER CASE letters.
Some commands received by the TP91 ask for a value to be sent back.These commands are as follows:-

COMMAND RECEIVED	TP91 ACTION
R	sends character string in the rate display field.
L	sends character string in the limit display field.
T	sends the current temperature value.

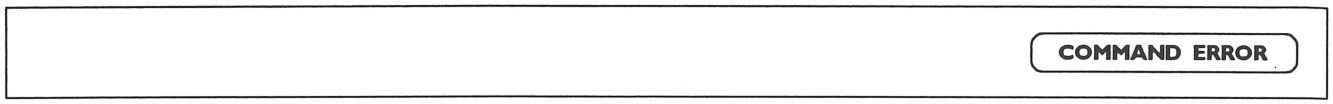
NOTE: Data received for the R command when in HOLD will be HO. Data received for the L command when in heat or cool mode will be HEAT or COOL. Data received is checked and if an incorrect value is detected then a message is displayed. e.g.if a limit of 610 was received then the following message will appear:-

LIMIT ERROR

The number of characters is also checked and if too many are received then this message appears:-



If a command is received that is not understood then this message appears:-



The other commands which do not require a value to be transmitted back to the computer are:-

COMMAND RECEIVED	TP91 ACTION
S	starts the profile.
Rvalue	stores the rate value received.
Lvalue	stores the limit value received.
E	exits the profile.
H	do heat function.
C	do cool function.
O	do hold function.

Sample programme

Commands from the computer which require the TP91 to transmit data, will be handled within about 0.5mS. Due to the interaction of the computer's language and hardware, sending a command such as 'T' and then immediately reading the input buffer can cause problems, especially if the computer does not respect the RTS/CTS handshake lines. If the computer language used allows the input buffer to be checked to see if it is empty then this can be used as a wait or interrupt request so that hardware buffers can be read into the string variable. If this cannot be done then a small delay will have to be inserted between sending out the command and receiving the data back. This delay will be in the order of about 20mS. For example in Microsoft's ® GW Basic a delay using a For-Next loop of 120 will work on either a 12MHz 286 or a 25MHz 386 computer.
When used with MICROSOFT WINDOWS 3.0 © and a 386 the enhanced mode should be used and the multitasking minimum time slice should be set to at least 10 msec. For 286 systems a PIF file should be used. This is necessary so that the TP 91 can finish it's data send.
The following programme is an example in Microsoft's © GW-BASIC showing :-

1) How to set up a rate of 20°/ min to a limit of 100.
2) Starting the TP91.
3) Reading the temperature.
4) Reading the limit value.
5) Setting a new rate value of 10°/ min .
6) Cool function.
7) Finish programming.

The following assumes that the computer is using the COM2 PORT which is set as follows:- 9600 baud, 8 data bits, 1 stop bit and no parity. This sample program serves only as a guide to the character strings necessary for input or output to take place and does .

```
CLOSE                          ;close all files
OPEN "COM2:9600,N,8" AS #1     ;opens a logical file 1 for the com2 port
R$(1)=''R20":L$(1)=''L100"     ;20°/ min to 100.
PRINT #1,R$(1)                 ;send the ramp value.
PRINT #1,L$(1)                 ;send the limit value.
PRINT #1,''S''                 ;send start command
REM WAIT ABOUT 8 SECONDS WHILE THE TP 91 STARTS AS THE RTS LINE WILL BE LOW
PRINT #1,''T''                 ;send transmit temp command
INPUT #1,TEMP$                 ;receive temperature string from TP91 into TEMP$
PRINT #1,''L''                 ;send transmit current limit command
INPUT #1,LIMIT$                ;receive limit string from TP91 into LIMIT$
PRINT #1,''R10''               ;send a new rate of 10°/ min.
PRINT #1,''C''                 ;send cool function command
PRINT #1,''E''                 ;send finish command
CLOSE #1
```

PT 91 PRINTER

The PT91 printer is a 24 column plain paper impact printer with built in rechargeable batteries. The power adaptor provided can be used to re-charge the batteries or to power the printer. It has a serial interface and connects to the computer serial port on the rear of the TP91. For safety reasons the printers are dispatched without the batteries charged and will require a full charge cycle before the batteries can be used. This will take about 14 hours, after which text can be printed using the batteries for about one hour. The power adaptor can be used if the batteries are not required.

The TP91 sends the current display contents to the printer when the remote control STORE key is pressed. The TP91 must be told that a printer is attached to it and is set up as follows. Once initialised the TP91 will remember that the printer is present. If for some reason the printer is not required, but the STORE function from the remote control is to be used, the TP91 should be reset to no printer.

TP91 printer on/off control

STEP	PRESS KEYS	DISPLAY BEFORE ENTER
Press the RATE/10 key as soon as this message appears.	RATE /10	LINKAM TP91
The following message will appear for a few seconds.		PRINTER SET UP
Press either RATE/STEP to turn the printer off or press HOLD to turn it on. The TP91 will then reset.		STEP=OFF/HOLD=ON

Interface

The cable supplied has two 25 way 'D' type plugs to connect the printer to the TP91. The connections in each plug are different, so one of the plugs which is marked TP91 should be connected to the TP91.

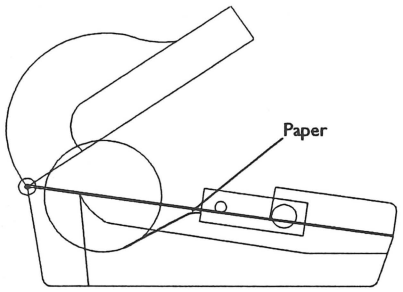
TP91 Transmit	pin 2	PT91 Receive	pin 3
Ready to send	pin 4	Clear to send	pin 5
Clear to send	pin 5	DTR	pin 20
Ground	pin 7	Ground	pin 7

Power on procedure

1 Check that the batteries are sufficiently charged or that the power adaptor is connected correctly. Open the lid and check that the paper and ribbon are present and that the paper well and mechanism are clear of debris. Close the lid, ensuring the paper is guided through the paper exit slot. Switch on the printer by pressing 1 on the switch panel. The power on indicator will light and the mechanism will reset.

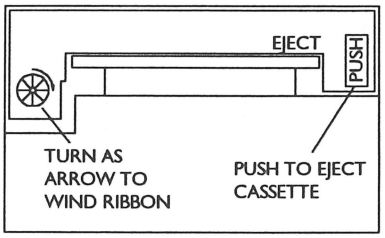
Paper Loading

If the paper roll needs replacing open the lid and remove the old paper using the feed switch to feed out any excess paper left in the mechanism. Do not pull the paper out of the back of the mechanism. Reel off a few centimetres from a new paper roll and check that the paper is square. Sit the new roll in the paper well with the paper end coming from the bottom of the roll. Make sure the power is on and place the paper into the back of the mechanism while pressing the feed switch. Keep the switch depressed unil enough paper is fed through the mechanism to be inserted through the paper slot exit in the lid. Feed the paper through the exit slot and close the lid.



Ribbon change

Turn the power off and open the lid. The cassette will clip off one side and can easily be removed. Check the new ribbon is taut. Clip it into position making sure that the paper still feeds between the ribbon and cassette body correctly. Wind the knob as shown to take up any slack in the ribbon. Close the lid.



Paper feed

For a single line paper feed press and release the feed switch. For continuous line feed keep the switch down. The power indicator turns off when the feed switch is down.

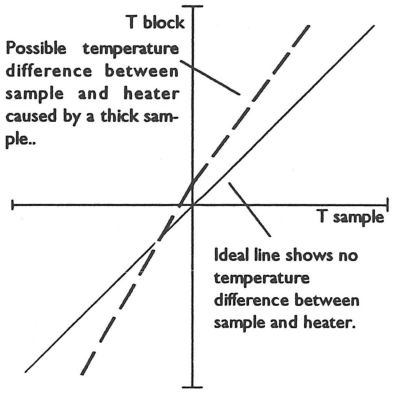
Self test

1 To start a self test press both the power on and the feed switch until the test starts. This will check the mechanism and a large proportion of the hardware and software without connection to another source. The software issue used by the printer is printed in double height, double width text, followed by the character set in normal text. Switch off and on again for normal operation.

SAMPLE CALIBRATION FOR THM600/HFS91 STAGES

The output from the platinum resistor in the THMS/HFS91 stage is accurately converted to temperature in the TP 91 to better than 0.1°C. The platinum resistor is mounted as near to the top surface of the silver block as possible, which due to it's high thermal conductivity gives very little temperature difference between the top surface and the platinum resistor. However, when the sample is thick or if the sample is placed on a cover slip or crucible, it is possible that some temperature gradient can appear, causing the known temperature characteristics of a material to change. For further information see the section SAMPLE CALIBRATION in the stage manual.

Using the sample calibration features of the TP 91, these known values and the experimental values can be used by the TP 91 to draw a new temperature curve. A positive and a negative temperature as well as a value for zero can be entered, although it is not necessary to enter all three sets of data. For instance the zero value can be left at zero and just a positive or negative value determined and entered.



The following procedure outlines the entry of three sets of data points. These values are entered as six temperatures in the following order: actual negative value, measured negative value, actual zero value, measured zero value, actual positive value and finally the measured positive value. If only one pair of values is to be changed the other values can be left the same by pressing the HOLD key. When the temperature value is asked for, the old value will be displayed and will then change when the LIMIT control is turned. If the RATE/10 key is pressed the change in the value as the control is turned will be 0.1°C but if the RATEX10 key has been pressed the change will be 1°C. When the instrument is delivered or if an instrument calibration is carried out the values are set to -100,-100,0,0,300,300. This effectively means that there are no calibration factors set, as the actual and measured values are the same.

Before a set of calibration temperatures can be determined on the stage, the existing calibration factors must be removed. This ensures that the TP91 reads the sensor's resistance directly and converts it without using the calibration factors. This is done as shown below and will set the existing measured and actual values for the end points to be the same. The zero point will be set to zero.

Removing the existing calibration values

STEP	PRESS KEYS	DISPLAY BEFORE ENTER
Press the HEAT/COOL key as soon as this message appears.	HEAT COOL	LINKAM TP91
The following message will appear for a few seconds.		SAMPLE CALIBRATE
Press the RATE/STEP key to reset the calibration values.	RATE STEP	STEP=RESET CALIB

New calibration values

The TP91 and stage may now be used in the normal way to determine the melting points which are then entered as shown below. In this example we will assume that the factory set values of -100,-100,0,0,300,300 are still set and will be displayed before each new entry.

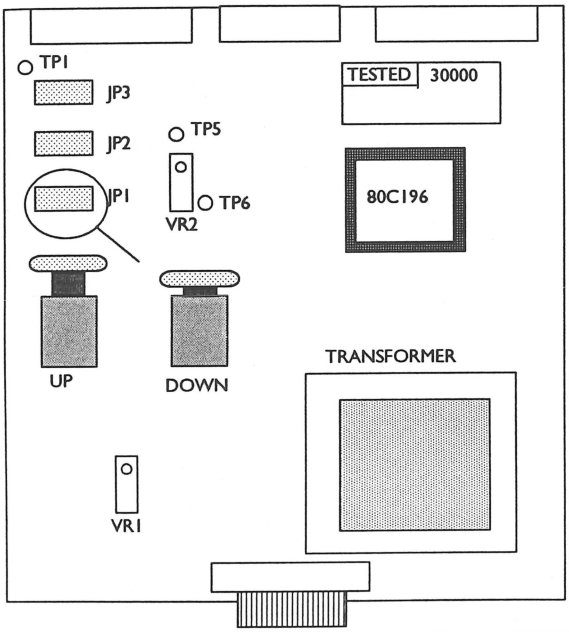
STEP	PRESS KEYS	DISPLAY BEFORE ENTER
Press the HEAT/COOL key as soon as this message appears.	HEAT COOL	LINKAM TP91
The following message will appear for a few seconds.		SAMPLE CALIBRATE
Press the HEAT/COOL key to start entering the new calibration values.	HEAT COOL	STEP=RESET CALIB
Turn the LIMIT control until the actual negative value is displayed. Press HOLD.	LIMIT HOLD	VALUE 1 ? -45

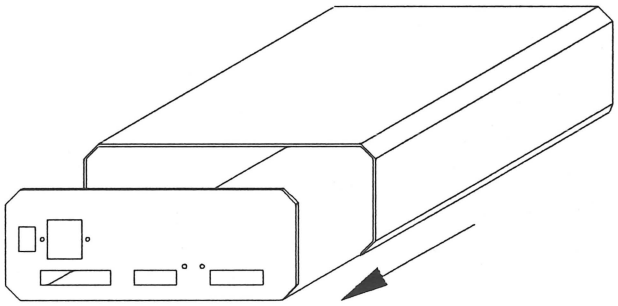
STEP	PRESS KEYS	DISPLAY BEFORE ENTER
Turn the LIMIT control until the measured negative value is displayed. Press HOLD.	LIMIT HOLD	VALUE 2 ? -46
Turn the LIMIT control until the actual zero value is displayed. Press HOLD.	LIMIT HOLD	VALUE 3 ? 0
Turn the LIMIT control until the measured zero value is displayed. Press HOLD.	LIMIT HOLD	VALUE 4 ? 0.7
Turn the LIMIT control until the actual positive value is displayed. Press HOLD.	LIMIT HOLD	VALUE 5 ? 337
Turn the LIMIT control until the measured positive value is displayed. Press HOLD.	LIMIT HOLD	VALUE 6 ? 339

On completion the TP91 will reset and will now show the temperature modified by the calibration factor.

INSTRUMENT CALIBRATION

The only instrument required to calibrate the TP91 is a four and a half digit multimeter e.g one that can read to1.9999 volts.
A calibrated source of resistance is fitted to each unit with it's value printed in the top right hand corner of a TESTED label which can be found near the back of the instrument.
In the calibration procedure JP1, JP2 and JP3 refer to a small switch which is mounted on the printed circuit board in the positions shown below.
The multimeter should be set on a high impedance 2 volts d.c. range with its -ve input connected to TP1.
Switch off the TP 91 and open the case as shown. The case sleeve should be placed on it's side by the chassis.





STEP	PRESS KEYS	DISPLAY BEFORE HOLD
Switch on and press the HOLD key when the LINKAM TP91 message appears.	HOLD	LINKAM TP91
The following message will appear for a few seconds.		TP 91 CALIBRATION
If the instrument calibration is not required press the STEP key. To continue press HOLD.	HOLD	STEP=EX / HOLD=CAL
Unplug the stage lead at the TP91 end. Press hold.	HOLD	UNPLUG LEAD>HOLD
Push down JP2 and JP3. Press HOLD.	HOLD	JP2&3 DOWN>HOLD
Connect the multimeter to TP5. Press HOLD.	HOLD	DC V ON TP5 >HOLD
Adjust VR1 until the TP91 display value is the same as the multimeter. Press HOLD.	HOLD	VR1=***** >HOLD
Push JP1 down. Press HOLD.	HOLD	JP1 DOWN >HOLD
Pull JP1 up. Press HOLD.	HOLD	JP1 UP >HOLD
Enter the resistor value from the TESTED label by turning the limit knob and pressing HOLD.	LIMIT HOLD	CAL R=***** >HOLD

STEP	PRESS KEYS	DISPLAY BEFORE HOLD
Connect the multimeter to TP6. Press HOLD.	HOLD	DC V ON TP6 >HOLD
Adjust VR2 until the multimeter reads 0 volts. Press HOLD.	HOLD	VR2 TP6=0 >HOLD
This message will appear for about 10 seconds.	HOLD	CALB ANALOG O/PS
Pull JP2 and JP3 up.Press HOLD.	HOLD	JP2&3 UP >HOLD
Re-connect the stage lead to the TP91. Press HOLD.	HOLD	STG LEAD IN >HOLD

NOTE:
INSTRUMENT CALIBRATION WILL SET THE SAMPLE CALIBRATION VALUES TO THE DEFAULT TEMPERATURES OF -100, 0 AND 300°C. THE REMOTE CONTROL RATES WILL BE SET TO 5, 10 AND 20°C/MIN AND THE TP91 WILL BE SET TO NO PRINTER FITTED

HARDWARE DESCRIPTION

Main board

The heart of the system is a 16 bit 80C196KB12 microcontroller with 2K of non_volatile ram addressed at 8000H to 87FFH and 32K of eprom mapped at 0000H to 7FFFH.The low order address and data lines are multiplexed so an 74ACT573 latch is used to latch out the A0 to A7 lines using the ALE line from the 80C196. D8,R45 and C27 form the reset signal which is connected through a schmitt trigger nand gate to the 80C196KB12 reset input.This is also connected though R43, TR4 and R38 to level shift the reset signal to -15 volts which is required for the front panel control ic's. Address decoding takes place in a dual 2 to 4 line 74LS139 decoder providing ram enable,keyboard enable,remote enable and video enable signals. A 74C922 keyboard encoder scans and decodes the front panel switch matrix.A data available signal drives and interrupt input on the 80C196KB12. The MAX232 is a two input two output RS232 line driver/receiver with built in dc-dc convertor for the +/- 12 volt logic levels.The signals supported are RX. TX,RTS and CTS.
The 7135 a/d converter has a resolution of 1 in 20000 and is a dual slope integrating type and is clocked at 500 kHz from the divided down 6MHz from the 80C196KB12.The a/d's reference voltage on TP2 of 1 volt is divided down from a 2.5 volt reference IC U1. U1 also provides the reference voltage for the two mark-space d/a convertors formed around U2,U3B and U6.The reference voltage is switched by a highly accurate mark-space signal from the 80C196 through U2 to an active low pass filter which produces a dc signal.U6 provides the analog temperature signal and has an offset pot VR2 to set the zero.The ramp output from U3B is calibrated in software by using the a/d.
All the signals to the a/d pass through U5 so that the ramp,temperature and platinum resistor signals can be measured. U3D,TR1,TR2 form a constant current source whose reference current is set by RD1 and R2.The output can be connected to both the reference resistor mounted on the board or to the platinum resistor of the stage.JP2 selects whether the
calibration resistor or the stage resistor is used.The voltage produced across either of the two resistors is gained and buffered in U3C.The current is approximately 1 mA and the gain of the buffer is about 6 so for a resistance of 300 ohms the output on TP5 will be about 1.8 volts.The difference between the temperature and the ramp signal is amplified in U8 with further amplification
in U7A to form a control voltage for the oscillator formed around U7B.This output controls the switching of TR9 which either allows the zero crossing signal through to TR8 or switches TR8 off. The output from TR8 is then used to trigger the output triac driver and to drive the load led.There are two optically isolated triac drivers,one for each of the two load voltages that can be switched onto the load.These are selected by TR7 and TR5.
The power supply produces a +/- 15 volt analog supply,+/- 5 volt analog supply and a logic 5 volt supply.A minus -25 volt supply is also used for the vacuum fluorescent display (VFD) drivers and a centre tapped 4.8 volts is used for the heater in the VFD.

Front panel board

The keys are arranged in a matrix which is decoded on the main board by a 74C922 decoder.
The VFD hasa single line of16 characters made up of 14 segments each. Both the anodes and grids are driven by a Rockwell 10937 display controller with pull down resistors on the grids.